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ON THE MISSISSIPPI VALLEY UNIONIDÆ FOUND  
IN THE ST. LAWRENCE AND ATLANTIC  
DRAINAGE AREAS.

BY CHAS. T. SIMPSON.

The entire Mississippi drainage area is peopled by a peculiar Unione Fauna.<sup>1</sup>

The species are exceedingly numerous. and many of them attain great size, or become very solid at maturity. A large number are characterized by strong sculpture in the form of knobcs, pustules or plications, or by striking outlines, and the species in general are more richly colored externally or internally than those of any other part of the globe.

The Atlantic drainage area, including a considerable part of the St. Lawrence River system, is occupied by a very different Naiad fauna. As a rule the species are moderate in size and conform nearly to the ordinary oval or oblong-oval Unione type; they are of light structure, without sculpture or strong angularities and lobes, and are plain colored in nacre and epidermis.

The dividing line between these two Unione faunas is not directly on the Height of Land, which separates the St. Lawrence and some of the other Atlantic drainage systems from that of the Mississippi, but it is considerably to the northward and north-eastward of it.<sup>2</sup>

To the westward the Red River of the north, the Saskatchewan and Mackenzie are largely inhabited by Mississippi Valley Uniones, and they are found abundantly in all the great lakes, the southern peninsula of Michigan, the streams in Wisconsin, Indiana and Ohio that drain into these lakes, and well up into Eastern Canada, Lake Champlain and

<sup>1</sup> See paper by the writer "On the Relationships and Distribution of the North American *Unionidæ*" in *Am. Naturalist*, XXVII, p. 353.

<sup>2</sup> This matter will be discussed in a paper by the writer, which will soon be published in the *Proc. N. S. National Museum* "On the Classification and Distribution of the Naiades,"

the Hudson River, in some places mingling with the forms belonging to the Atlantic drainage area proper, in others occupying the waters exclusively.

I think we may safely take it for granted that the only way in which the Mississippi Valley *Unionidæ* could have entered these northern and north-eastern river systems was by migrating along connecting fresh water. As there is no such connection to-day between these systems the question as to how they reached their present distribution becomes an extremely interesting one.

If the theory of the Ice Age as held by most glacialists is a true one I think it will fully explain the present remarkable distribution of these extra-limital Mississippi Valley Naiades. And at the same time I believe the evidence of these fresh water mussels is strongly corroborative of the glacial theory. It is held that at the close of the Ice Age a great cap of ice of immense thickness covered North America east of the Rocky Mountains, down to about Latitude 40°. That with the coming on of warm weather it gradually melted away at its southern extremity, and that when this thawing was continued north of the height of land great lakes were formed whose southern shores were the slope of the land which raised towards the south, and whose northern borders were the slowly dissolving wall of ice. On account of the ice to the northward this water could only drain into the Mississippi system, or to the Southeastward, and several old channels are found through which it is believed that it flowed. One of these is the Red River of the North, which almost connects by means of Traverse Lake at its head with Big Stone Lake at the head of the Minnesota River. There is still a broad channel near the western end of Lake Superior which connects with the St. Croix River, and at Chicago there was no doubt an overflow from Lake Michigan into the Des Plaines River, and Lake Erie is believed to have had its outlet into the Wabash through the Maumee which nearly connects with it. The two streams are connected over a very flat country by an old channel not less than a mile and a half wide, and having an average depth of 20 feet. For 25 miles this character continues, and there is

very little fall either way. To the northeast this channel opens out into an ancient lake, and at the southwest it touches bed rock at Huntington, and then descends more rapidly.<sup>3</sup>

It will be noticed on the map that the St. Josephs, St. Mary's, and Auglaize Rivers, tributaries of the Maumee, flow in the direction of the Wabash, that the two former join at Fort Wayne and flow partly backward as the Maumee; the whole looking like a tree with its branches broken down, and hanging against its trunk. If the river was continued into the Wabash, and the water all flowed to the southwest it would form a natural looking system. It is quite within the bounds of probability that there were old overflows from the St. Lawrence drainage to the eastward of this through the Oswego River into the Mohawk, or by way of the Sorel into the Hudson, and possibly through eastern Lake Erie into the Alleghany system.

Now if the water from this region north of the Height of Land flowed over into the Mississippi drainage area at various places it would be almost certain that the *Unionidæ* of this system would migrate up these overflows and into the northern lakes, that in this region they would obtain a foothold and flourish, for the reason that at the time of their entrance it is quite probable that all freshwater life of this area was destroyed by the grinding and crushing of the great ice cap. It is possible that a few of the Naiades of the eastern drainage system might have survived in the St. Lawrence Valley but it is more likely that such as are now found there have since reached that region by migration from the overflows through the Mohawk and Oswego Rivers, or the Sorel. There has probably been at some time since the close of the Glacial Epoch a connection between the Hudson River and Lake Champlain, as the latter is largely peopled with Mississippi Valley *Naiades*. These forms, most likely, entered Lake Erie through the old Maumee Channel, or by some connection with the Upper Ohio system, passed into Lake Ontario, thence through the Oswego

<sup>3</sup> See a paper "On the Ancient Outlet of Lake Michigan," by Prof., W. M. Davis. Pop. Science Monthly, XLVI, No. 2, p. 217. Also a paper on this old system by G. K. Gilbert, in the first volume of the Ohio Geological Survey.

and Mohawk Rivers into the Hudson, and across into Lake Champlain; or they may have gone down the St. Lawrence and up the Sorel. If by a subsidence since that time Lake Champlain has been connected with the ocean, as is now believed, the Naiads of that lake no doubt retreated up the small streams flowing into it, and returned after the elevation of the land when its waters again became fresh.

I think I am not making too sweeping an assertion when I say that all the Mississippi Valley species of Naiades that have entered the St. Lawrence, or in fact any part of the Atlantic drainage areas, have become changed in some of their characters. As a rule, though not in every case, they have become smaller, and simpler in their outlines; the sculpture is less pronounced or is almost obliterated; in many cases the shells are thinner, the nacre has lost its brilliancy, and instead of the bright epidermis, often painted beautifully with rays or a wonderful pattern of rich greens, yellows, and olives, we have mostly dull, livid, ashy or rusty reddish or brownish exteriors, and they are very often somewhat distorted. This is not, as I believe, in any great measure due to climate or colder water, for these same species are as vigorous and finely developed in parts of Wisconsin drained into the Mississippi, Minnesota and Dakota as in any part of their area; besides *Anodonta edentula* under the name of *A. undulata*, and *Unio* (*Margaritana*) *marginata* when found in Maryland, Virginia, and probably even south of that are so dwarfed and stunted as to be scarcely recognizable. This changing of characters has been well illustrated in a lot of *Unionidæ* recently submitted to me for examination by Prof. B. W. Everman of the U. S. Fish Commission, which was collected mostly from the Maumee basin by Dr. Philip H. Kirsch, of Columbia City, Indiana. This region lies in Lat.  $41^{\circ}$  to  $41\frac{1}{2}^{\circ}$ , the most southerly part of the St. Lawrence drainage. *Unio. luteolus* Lam., *U. subrostratus* Say, *U. circulus* Lea, *U. phaseolus* Hild., *U. multiplicatus* Lea, *U. multiradiatus* Lea, and *Anodonta grandis* Say, are so dwarfed and stunted, and changed in color as to be scarcely recognizable, while the same species from the Wabash, from which these have no doubt all been derived, are as vigorous and finely developed as any in the Mississippi Valley.

This great change in size, form and coloring has caused students to bestow many specific names on what I believe are merely northern races or varieties of common Mississippi Valley species. Thus Anthony's *Anodonta subangulata* and Lea's, *A. footiana*, *A. marryattana* and *A. benedictii* are merely dwarfed and slightly changed forms of Say's, *A. grandis*. Anthony's *A. subinflata* is probably a form of *A. corpulenta* Cooper, and *A. subcylindracea* Lea, is the northern manifestation of Lea's well known *A. ferussaciana*. Say's *Anodonta edentula* becomes in Michigan *Alasmodonta rhombica* of Anthony, and further east and southeast *A. undulata* of Say; Lea's *Unio circulus* of the central Mississippi area changes in Lake Erie to the dwarf *U. leibi* of the same author; his *U. canadensis* is only an altered over *U. ventricosus* of the western States, and A. Gray's *U. borealis* is a very much changed form of the common *U. luteolus*, while *U. hippopæus* Lea, of Lake Erie is, I believe, only a stunted *U. plicatus* that has almost entirely lost its plications, and has assumed a dirty, reddish or olive color.

Some of these are possibly valid species; most of them would certainly be considered so, together with a number of other northern manifestations of Mississippi Valley species were it not that so many intermediate links are found.

It sometimes happens that specimens of a given species are found in the Mississippi area, growing, no doubt, under unfavorable conditions, that so closely imitate the same species found in northern waters as to be indistinguishable from it. Thus Lea has in his collection what he called *Anodonta footiana*, a Michigan form, from Illinois, and depauperate *Unio plicatus* are sometimes found in the Mississippi area that are almost exactly like *U. hippopæus*. And on the other hand occasionally fine specimens of *Unio rectus*, *U. rubiginosus*, *Anodonta ferussaciana* and *A. grandis* are found in the St. Lawrence drainage that are perfectly normal. Yet as a rule an expert can tell at a glance whether a specimen grew in the Mississippi area or was extra-limital.

*Anodonta simpsoniana* Lea, is, I believe, a good species, although it is probably an altered and dwarfed *A. grandis*.

It is possible that here we have an opportunity to make some kind of an estimate as to the time required in developing species and varieties among the *Unionidæ*. It is well known that the Laramie strata of the northwest, belonging perhaps to the upper cretaceous or earlier Tertiary systems contain the remains of a large number of Unios which appear to be very closely related to existing Mississippi Valley forms, and are probably their progenitors. Some of these old fossils are so much like certain recent species that they might easily be taken for them by an expert, and nearly or quite all of them can be placed in existing groups.

Yet it is more than probable that the great variety of changes that have been produced in the Mississippi Valley forms which now inhabit the St. Lawrence drainage area have taken place since the Ice Age began to draw to a close, because it is almost certain that all fluviatile and lacustrine life under the ice sheet was destroyed, and that any forms closely allied to those of the Mississippi Valley now found north of the Height of Land migrated there since. It is held by most glaciologists, I believe, that the Glacial Epoch reached down probably to within from 10,000 to 20,000 years of the present. This amount of time might probably be taken as the age of these peculiar forms of St. Lawrence Mississippi Naiades.

*Unio radiatus*, *ochraceus*, *cariosus*, *heterodon*, *tappanianus*, and *Margaritana undulata*, which are found in the Atlantic drainage south of the line of the ice cap, and which are all closely related to common Mississippi Valley forms are probably older, and may have been derived from some migration made from the western to the eastern drainage at a much earlier date. At any rate I believe that all the Uniones which belong properly in the Atlantic drainage system were derived at one time and another from Mississippi Valley species; that some peculiarity of environment common to this entire region has had a tendency to dwarf them, to simplify their forms and dull their colors.